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EXAMINER

SONG, MATTHEW J

ART UNIT

PAPER NUMBER

1765

DATE MAILED: 09/02/2003

Please find below and/or attached an Office communication concerning this application or proceeding.

# Office Action Summary

Application No.

10/058,353

Applicant(s)

OGURI ET AL.

Examiner

Matthew J Song

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-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

## Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133).
- Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

## Status

- 1) ☒ Responsive to communication(s) filed on 25 June 2003.
- 2a) ☐ This action is **FINAL**. 2b) ☒ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

## Disposition of Claims

- 4) ☒ Claim(s) 1-30 is/are pending in the application.
- 4a) Of the above claim(s) 1-13 and 19-27 is/are withdrawn from consideration.
- 5) ☐ Claim(s) \_\_\_\_\_ is/are allowed.
- 6) ☒ Claim(s) 14-18 and 28-30 is/are rejected.
- 7) ☐ Claim(s) \_\_\_\_\_ is/are objected to.
- 8) ☐ Claim(s) \_\_\_\_\_ are subject to restriction and/or election requirement.

## Application Papers

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☐ The drawing(s) filed on \_\_\_\_\_ is/are: a) ☐ accepted or b) ☐ objected to by the Examiner.
- Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).
- 11) ☐ The proposed drawing correction filed on \_\_\_\_\_ is: a) ☐ approved b) ☐ disapproved by the Examiner.
- If approved, corrected drawings are required in reply to this Office action.
- 12) ☐ The oath or declaration is objected to by the Examiner.

## Priority under 35 U.S.C. §§ 119 and 120

- 13) ☒ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☒ All b) ☐ Some \* c) ☐ None of:
1. ☒ Certified copies of the priority documents have been received.
2. ☐ Certified copies of the priority documents have been received in Application No. \_\_\_\_\_.
3. ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).
- \* See the attached detailed Office action for a list of the certified copies not received.
- 14) ☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. § 119(e) (to a provisional application).
- a) ☐ The translation of the foreign language provisional application has been received.
- 15) ☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. §§ 120 and/or 121.

## Attachment(s)

- 1) ☒ Notice of References Cited (PTO-892)
- 2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
- 3) ☒ Information Disclosure Statement(s) (PTO-1449) Paper No(s) 3.
- 4) ☐ Interview Summary (PTO-413) Paper No(s). \_\_\_\_\_.
- 5) ☐ Notice of Informal Patent Application (PTO-152)
- 6) ☐ Other: \_\_\_\_\_.

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## DETAILED ACTION

### *Election/Restrictions*

1. Claims 1-13 and 19-27 are withdrawn from further consideration pursuant to 37 CFR 1.142(b) as being drawn to a nonelected invention, there being no allowable generic or linking claim. Election was made **without** traverse in Paper No. 6.

### *Claim Rejections - 35 USC § 102*

2. The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

A person shall be entitled to a patent unless –

(b) the invention was patented or described in a printed publication in this or a foreign country or in public use or on sale in this country, more than one year prior to the date of application for patent in the United States.

(e) the invention was described in (1) an application for patent, published under section 122(b), by another filed in the United States before the invention by the applicant for patent or (2) a patent granted on an application for patent by another filed in the United States before the invention by the applicant for patent, except that an international application filed under the treaty defined in section 351(a) shall have the effects for purposes of this subsection of an application filed in the United States only if the international application designated the United States and was published under Article 21(2) of such treaty in the English language.

3. Claim 14 is rejected under 35 U.S.C. 102(b) as being clearly anticipated by Imai et al (US 5,373,171).

Imai et al discloses an n-type silicon carbide single crystal, which contains at least one impurity element selected from the group consisting of nitrogen, phosphorus, arsenic, antimony and lithium (col 3; ln 45-65), this reads on applicant's crystalline structure containing arsenic.

4. Claims 16-18 and 28-30 are rejected under 35 U.S.C. 102(b) as being anticipated by Carter et al (US 6,025,289).

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Carter et al discloses large single crystal of silicon carbide are grown in furnace sublimation systems and the crystal are grown with compensating levels of p-type and n-type dopants, note entire reference. Carter et al also discloses a single crystal of silicon carbide having a nitrogen dopant, this reads on applicant's atom having a smaller radius than silicon, and an aluminum dopant, this reads on applicant's p-type dopant having a larger atomic radius than carbon, each being present in the crystal at a concentration of between about  $1 \times 10^{16} \text{ cm}^{-3}$  and  $1 \times 10^{18} \text{ cm}^{-3}$  and the concentration of aluminum dopant atoms being in the range of about 1 to 5 times that of nitrogen dopant atoms (Abstract and Claim 1). Carter et al is silent to the atomic radius of nitrogen and aluminum, however the atomic radius of aluminum is well known in the art to be larger than carbon and the atomic radius is well known in the art to be less than silicon, note Inomate et al (US 4,827,235) and Aoki et al (US 5,998,609).

Referring to claim 18, Carter et al disclose aluminum, this reads on applicant's metallic atom other than light metals having a larger atomic radius than silicon in a crystalline because applicant has defined light metals as sodium, potassium, calcium and scandium, note pg 13, ln 15-20 of the instant specification.

Referring to claim 29-30, Carter et al discloses a concentration of aluminum and nitrogen to be  $1 \times 10^{16} \text{ cm}^{-3}$  and  $1 \times 10^{18} \text{ cm}^{-3}$ , this reads on applicant's claimed range.

5. Claims 16-18 are rejected under 35 U.S.C. 102(e) as being anticipated by Carter, Jr et al (US 6,218,680).

Carter, Jr et al discloses silicon carbide single crystals have a concentration of nitrogen atoms, this reads on applicant's n-type dopant having a smaller atomic radius than silicon, below

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about  $1 \times 10^{17} \text{ cm}^{-3}$  and a concentration of vanadium, this reads on applicant's metallic atom other than light metals having a larger atomic radius than silicon, is less than  $1 \times 10^{16} \text{ cm}^{-3}$  (col 5, ln 15-45 and claims 31 and 35).

Referring to claim 17, Carter, Jr et al discloses a concentration of nitrogen is  $1 \times 10^{17} \text{ cm}^{-3}$  or less (col 5, ln 20-25), this reads on applicant's concentration of  $1 \times 10^{16}$ -  $1 \times 10^{20} \text{ cm}^{-3}$ .

Referring to claim 18, Carter, Jr et al discloses a concentration of vanadium is less than  $1 \times 10^{16} \text{ cm}^{-3}$  (col 5, ln 28-35), this reads on applicant's concentration of  $1 \times 10^{14}$ - $1 \times 10^{18} \text{ cm}^{-3}$ .

6. Claims 16-18 are rejected under 35 U.S.C. 102(b) as being anticipated by Carter et al (US 5,718,760).

Carter et al teaches n-type and p-type doped single crystalline SiC, note entire reference. Carter et al also teaches other dopants may be used (col 3, ln 60-65). Carter et al also teaches each dopant type is present in the crystal at a concentration between about  $1 \times 10^{16}$ - $1 \times 10^{18} \text{ cm}^{-3}$  (claim 1 and 5 and col 3, ln 15-30). Carter et al also teaches a p-type dopant of aluminum (col 3, ln 1-67 and claim 9), where the aluminum dopant reads on applicant's metallic atom other than light metals having a larger atomic radius than silicon in a crystalline because applicant has defined light metals as sodium, potassium, calcium and scandium, note pg 13, ln 15-20 of the instant specification. Carter et al also teaches an n-type dopant of nitrogen (claim 8 and col 3, ln 1-67), where the nitrogen dopant reads on applicant's n-type dopant having a smaller atomic radius than silicon.

***Claim Rejections - 35 USC § 103***

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7. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

8. Claim 15 is rejected under 35 U.S.C. 103(a) as being unpatentable over Imai et al (US 5,373,171).

Imai et al discloses all of the limitations of claim 15, as discussed previously, except the concentration of arsenic is from  $1 \times 10^{16}$  to  $1 \times 10^{20} \text{ cm}^{-3}$ . The concentration of a dopant atom is well known in the art to be a result effective variable. Therefore, it would have been obvious to a person of ordinary skill in the art at the time of the invention to modify Imai et al by optimizing the concentration of arsenic to obtain same by conducting routine experimentation of a result effective variable. The selection of reaction parameters such as temperature and concentration is obvious (In re Aller 105 USPQ 233, 255 (CCPA 1955)).

9. Claim 15 is rejected under 35 U.S.C. 103(a) as being unpatentable over Imai et al (US 5,373,171) in view of Suzuki et al (US 5,063,421).

Imai et al discloses all of the limitations of claim 15, as discussed previously, except the concentration of arsenic is from  $1 \times 10^{16}$  to  $1 \times 10^{20} \text{ cm}^{-3}$

In a method of forming a silicon carbide light emitting diode, Suzuki et al teaches an n-type SiC single crystal layer 5 had a carrier concentration of about  $1 \times 10^{18} \text{ cm}^{-3}$  (col 5, ln 40-50). It would have been obvious to a person of ordinary skill in the art at the time of the invention to modify Imai et al with Suzuki's carrier concentration to form a useful light emitting diode (col 5,

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In 19-40). Furthermore, the selection of reaction parameters such as temperature and concentration is obvious (In re Aller 105 USPQ 233, 255 (CCPA 1955)).

10. Claims 16-18 are rejected under 35 U.S.C. 102(b) as anticipated by or, in the alternative, under 35 U.S.C. 103(a) as obvious over Carter et al (US 5,718,760) or Carter et al (US 6,025,289) in view of Larkin et al (US 5,709,745).

Carter et al ('760) or Carter et al ('289) discloses all of the limitations of claim 16, as discussed previously, except if aluminum is a light metal and aluminum does not does not read on applicant's metallic atom.

In a method of forming SiC, Larkin et al teaches a p-type film layer of silicon carbide is formed by using aluminum, iron, titanium or vanadium (col 15, ln 1-37), where iron, titanium and vanadium reads on applicant's metallic atom. It would have been obvious to a person of ordinary skill in the art at the time of the invention to modify Carter et al ('760) or Carter et al ('289) with Larkin et al's p-type dopants of metallic atoms for SiC because substitution of known equivalents for the same purpose is held to be obvious. (MPEP 2144.06).

### ***Conclusion***

11. The prior art made of record and not relied upon is considered pertinent to applicant's disclosure.

Inomata et al (US 4,827,235) teaches the atomic radius of aluminum is 1.43 angstroms (col 6, ln 55-57).

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Aoki et al (US 5,998,609) teaches the atomic radius of carbon is 0.77 angstroms, the atomic radius of nitrogen is 0.74 angstroms and the atomic radius of silicon is 1.17 angstroms (col 10, ln 34-40).

Sano (JP 64-050480) teaches an N-type SiC layer with arsenic of  $4 \times 10^{17}/\text{cm}^2$  of carrier concentration (Abstract).

Barrett et al (US 5,611,955) teaches vanadium doped single crystalline SiC (Abstract and col 2, ln 60-67).).

12. Any inquiry concerning this communication or earlier communications from the examiner should be directed to Matthew J Song whose telephone number is 703-305-4953. The examiner can normally be reached on M-F 9:00-5:00.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Nadine Norton can be reached on 703-305-2667. The fax phone numbers for the organization where this application or proceeding is assigned are 703-872-9310 for regular communications and 703-872-9311 for After Final communications.

Any inquiry of a general nature or relating to the status of this application or proceeding should be directed to the receptionist whose telephone number is 703-308-0661.

Matthew J Song  
Examiner  
Art Unit 1765

MJS  
August 14, 2003

NADINE G. NORTON  
PRIMARY EXAMINER

